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Analysis of Soy Sauce

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SUMMARY

Thirty-eight samples of soy and soy type sauces were tested for nutrients of importance to consumers, either because of health concerns or nutrition. These included salt, sodium, MSG (monosodium glutamate), calories, and alcohol. Salt averaged 2.2 grams per tablespoon, sodium 856 mg (milligrams), MSG 26 mg, and calories 12. Alcohol was found in 21 samples and averaged 1.7%, but ranged from 0.2 to 4.4%.



Analysis of Soy Sauce

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Soy and similar type sauces are used for some ethnic foods (primarily Oriental) that are prepared at home or eaten at restaurants. These sauces may be used as an ingredient during cooking or added as a condiment after the food is served.

Two types of soy sauce are available; fermented and non-fermented (USDA). Fermented soy sauce is produced from the fermentation of soy beans with fermented mash, together with salt brine and preservatives, such as sodium benzoate. The fermented mash is derived from enzymatic digestion of Koji with salt brine and from fermentation by yeast and lactic acid bacteria. Koji is a mixture of wheat and soybeans cultured with the molds *Aspergillus oryzae* or *A. soyae*.

The non-fermented type is a blend of hydrolyzed vegetable protein, salt, corn syrup or sugar, caramel color, vinegar and/or other organic acids (such as acetic or citric acid) and water, with or without preservatives (USDA).

The only commercial description for soy sauce is provided by the U.S. Department of Agriculture (USDA). They categorize Type 1 (fermented) and Type 2 (non-fermented) and list analytical requirements for both types. These are shown in Table 1.

Consumers are especially concerned about food ingredients that may be important to health and nutrition.

Among such ingredients are salt, sodium, MSG (monosodium glutamate), calories, and alcohol. Since soy sauces usually contain these ingredients, we report amounts of these and other nutrients found in soy products. Additionally we tested soy sauces for compliance with USDA analytical requirements (Table 1).

METHODS

Thirty-eight samples of soy and soy type sauces were collected in April and September, 1991 at food stores in Connecticut by an inspector of the Connecticut Department of Consumer Protection. Analyses were by AOAC methods (Methods of Analysis) except as follows.

Sodium was tested by diluting the sample in water and then direct analysis by Inductively Coupled Plasma Atomic Emission Spectrometry. Monosodium glutamate (MSG) was determined by diluting the sample in water and quantified by High Performance Liquid Chromatography with UV detection at 340nm. Alcohol was determined by Gas Chromatography using propanol as the internal standard and calculated on a weight basis. Carbohydrates were calculated by difference. Calories were calculated as four calories per gram of protein and carbohydrate, nine per gram of fat, and 6.93 per gram of

Table 1. USDA analytical requirements for soy sauce

Requirement	Type 1 fermented	Type 2 non-fermented
Acidity (as acetic acid)	0.90-1.35%	0.8-1.6%
Total salt (as NaCl)	13.0-16.0%	13.0-21.0%
pH	4.5-5.2	4.5-6.0
Protein	nlt 7.5%	nlt 4.5%
Alcohol	1.0-3.5%	--
Total solids	nlt 28.0%	nlt 32.0%

nlt = not less than

alcohol. A tablespoon of soy sauce was taken as 18 grams (Composition of Foods).

RESULTS AND DISCUSSION

The percentages (grams per 100 grams or 3.5 ounces) of protein, carbohydrate, solids, salt, and alcohol are listed in Table 2 by brand name and style of product. The type, listed as 1 or 2, refers to specifications in Table 1.

Protein content averaged 7.1%, with a range from 0.8 to 15.8%. The average amount for one tablespoon (an approximate serving size) would be about 1.3 grams. Carbohydrate content, which is a measure of total sugars, and can include sucrose, corn syrup, molasses, and starch, ranged from none to 33.5%, with an average of 8.1%, or 1.5 grams per tablespoon. Solids indicate the amount of material, other than water, in the product. This averaged 28.1% with a range from 13.3 to 39.9%, or an average of 5.1 grams per tablespoon.

Alcohol was found in 21 samples (Table 2). Of these, only four claimed alcohol as an ingredient, either as alcohol or some type of wine. These four samples averaged 1.9% alcohol, with a range from 0 to 4.4%. The 17 others found to contain alcohol averaged 1.6%, but the range was wide, from 0 to 3.0%.

Nine samples would be classed as USDA Type 1, fermented, and would be expected to contain alcohol between 1 to 3.5% from fermentation. The nine averaged 2.5% alcohol and values ranged from 1.7 to 4.4%.

Four nutrients in soy sauces are of particular concern to consumers: sodium, salt, and MSG because of health concerns, and calories for nutrition. Salt content ranged from 5.1 to 19.9%, with an average of 12.1% (Table 2). Amounts of salt, sodium, MSG, and calories per tablespoon for each sample are shown in Table 3. The average salt (sodium chloride) content of all samples was 2.2 grams per tablespoon, and sodium was 856 milligrams (mg) per tablespoon.

Some products, besides being labeled as "lite", also claimed how much less sodium or salt they contained (Table 3). The average amount of sodium in all samples was 856 mg per tablespoon (18 grams) and for salt, 2.2 grams. Two samples labeled as 62% less sodium (Angostura Low Sodium Soy Sauce) contained 55% of the average amount of sodium. Two products labeled as 47% less sodium (LaChoy Lite Soy Sauce & LaChoy Teriyaki Marinade & Sauce) contained 71 and 54% of the average. The product labeled as 25% less sodium (San-J Tamari Lite Gourmet Soy Sauce) contained 16% of the average. The exact meaning of a designation of what "some % less sodium" means is not certain. It can mean less than other products of the same brand, or less than other brands.

Some people are sensitive to monosodium glutamate (MSG). MSG can be added as pure material directly to

soy products. It also may be incorporated as a portion of hydrolyzed vegetable protein and added directly to the product, or be from the fermented soy beans used in Type 1 (fermented soy sauce). The average amount of MSG in all samples was 26 mg per tablespoon, but ranged from 5 to 130 mg (Table 3). Seven samples were labeled as containing MSG (Table 3), and these averaged 48 mg per tablespoon. Three samples labeled as containing no MSG averaged 40 mg per tablespoon.

The number of calories per product was relatively low, averaging 12 per tablespoon. Quantities of protein and carbohydrate were relatively low (Table 2). Alcohol provides some calories, but amounts of alcohol per tablespoon were also low. Only one sample listed oil (sesame oil) as an ingredient.

Nine samples would be classed as USDA Type 1, and based on the data obtained, only two of these samples (K.A.M.E. Tamari Soybean Sauce & Kikkoman Naturally Brewed Soy Sauce) met all the USDA analytical requirements as listed in Table 1. Four contained too much acidity, one had an excess of alcohol, two were low in solids, and one was deficient in protein.

Of the 29 Type 2 samples tested, only two samples met all USDA analytical requirements (one LaChoy Soy Sauce All Purpose & Shop Rite Soy Sauce). Nine were deficient in protein, 12 were low in pH (a measure of acidity), 14 failed the acidity specification (8 were too low, 6 were too high), and 18 were deficient in solids content. Additionally, 18 contained too little salt, but six of these were labeled as light or lower in sodium.

ACKNOWLEDGMENTS

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Table 2. Nutrients in soy type sauces.

Brand, style	type	prot %	carb %	solids %	salt %	alc %
ANGOSTURA						
Low Sodium Soy Sauce	2	4.3	9.8	21.5	6.3	0.0
Low Sodium Soy Sauce	2	5.3	7.2	19.9	6.4	0.0
CHINA BOWL						
Lite Soy Sauce	2	3.9	4.9	29.3	19.9	0.2
JOYCE CHEN						
Szechuan Stir Fry Sauce ²	2	4.7	11.9	29.3	12.1	0.3
KA.ME						
Authentic Japanese Soy Sauce	2	2.7	2.0	13.3	8.5	0.6
Authentic Japanese Soy Sauce	2	3.3	1.5	15.1	10.7	0.6
Authentic Japanese Teriyaki Sauce & Marinade ^{2,5}	2	4.6	6.7	19.5	6.4	0.5
Chinese Dark Soy Sauce	2	3.1	8.4	27.7	15.8	0.0
Chinese Light Soy Sauce	2	4.0	7.0	29.0	17.4	0.2
Chinese Mild Soy Sauce	2	9.1	0.0	16.8	8.3	0.0
Hibachi Sauce	2	0.8	33.5	39.8	5.1	0.0
Tamari Soybean Sauce	1	8.4	6.0	28.7	13.1	1.8
KIKKOMAN						
Lite Soy Sauce	1	10.0	4.1	23.7	8.7	2.2
Naturally Brewed Soy Sauce	1	8.8	6.3	30.1	13.6	1.7
Naturally Brewed Soy Sauce	1	10.3	0.9	21.1	13.2	2.5
Naturally Brewed Soy Sauce	1	10.7	2.6	28.0	13.5	2.4
Naturally Brewed Tamari Soy Sauce ¹	1	15.8	2.5	34.6	14.1	3.0
Tempura Dipping Sauce	1	6.1	14.9	34.9	12.8	1.7
Teriyaki Marinade & Sauce ³	2	6.7	8.7	24.8	8.5	3.0
KOON CHUN						
Black Soy Sauce	2	6.8	11.7	39.9	19.6	0.0
LACHOY						
Lite Soy Sauce	2	10.1	8.7	34.2	12.1	0.0
Lite Teriyaki Marinade & Sauce	2	8.3	17.3	36.5	8.8	3.0
Soy Sauce All Purpose Seasoning	2	7.9	7.6	35.2	17.7	0.0
Soy Sauce All Purpose Seasoning	2	9.4	5.4	32.9	16.9	0.0
LEE KUM KEE						
Premium Soy Sauce ⁵	2	11.7	6.9	35.7	15.8	0.0
MEE TU						
Soy Sauce	2	1.2	20.3	33.0	11.1	0.0
Soy Sauce	2	2.1	15.1	30.2	12.5	0.0
Teri-Yaki Marinade Sauce	2	2.2	21.8	37.4	12.4	0.0
MITSUKAN						
Ajipon Sauce ⁵	2	5.4	2.4	17.8	9.4	1.0
Gyoza (Meat Dumpling) Sauce ^{5,6}	2	3.7	7.5	17.6	5.8	0.6
Shabu Shabu Sauce	2	6.3	7.7	22.8	8.1	1.5
PATHMARK						
Soy Sauce	2	9.6	3.6	29.4	14.7	0.0

Table 2. Nutrients in soy type sauces (continued).

Brand, style	type	prot %	carb %	solids %	salt %	alc %
SAN-J						
Tamari Lite Gourmet Soy Sauce ¹	1	13.8	4.8	30.4	10.2	4.4
SHOP RITE						
Soy Sauce	2	9.8	3.7	32.7	17.7	0.0
SUPERIOR						
Pearl River Bridge Soy Sauce	2	9.3	3.0	31.1	17.7	0.0
YAMASA						
Low Sodium Soy Sauce	1	8.6	6.5	27.9	12.2	2.5
Soy Sauce ^{4,5}	2	13.3	2.8	31.7	14.1	0.0
Teriyaki Sauce ⁵	2	6.9	10.2	25.2	7.5	1.0
AVERAGE FOR ALL SAMPLES		7.1	8.1	28.1	12.1	0.9

1 = labeled as containing alcohol

2= labeled as containing sherry

3= labeled as containing wine

4= labeled as containing sake

5= labeled as containing MSG (monosodium glutamate)

6= only sample labeled as containing oil (sesame oil)

Table 3. Sodium, salt, MSG (monosodium glutamate), and calories per tablespoon (18 grams) in soy type sauce.

Brand/style	Sodium, mg	MSG, mg	Calories, number	Salt, gms	Label
ANGOSTURA					
Low Sodium Soy Sauce	472	23	10.3	1.1	62% less sodium
Low Sodium Soy Sauce	468	26	9.0	1.2	62% less sodium
CHINA BOWL					
Lite Soy Sauce	1359	17	6.7	3.6	
JOYCE CHEN					
Szechuan Stir Fry Sauce ²	886	5	12.2	2.2	
KA.ME					
Authentic Japanese Soy Sauce	585	23	4.1	1.5	
Authentic Japanese Soy Sauce	736	23	4.1	1.9	
Authentic Japanese Teriyaki Sauce & Marinade ^{2,5}	544	130	8.6	1.2	MSG
Chinese Dark Soy Sauce	1157	49	8.3	2.8	no MSG
Chinese Light Soy Sauce	1251	65	8.1	3.1	no MSG
Chinese Mild Soy Sauce	587	6	6.7	1.5	no MSG, salt red. from 17 to 8.6%
Hibachi Sauce	351	6	24.7	0.9	
Tamari Soybean Sauce	968	7	12.6	2.4	
KIKKOMAN					
Lite Soy Sauce	646	17	13.0	1.6	40% less sodium than other brands
Naturally Brewed Soy Sauce	812	19	13.0	2.4	
Naturally Brewed Soy Sauce	981	23	11.2	2.4	
Naturally Brewed Soy Sauce	986	18	12.6	2.4	
Naturally Brewed Tamari Soy Sauce ¹	986	18	16.9	2.5	
Tempura Dipping Sauce	963	36	17.3	2.3	MSG
Teriyaki Marinade & Sauce ³	625	19	13.0	1.5	
KOON CHUN					
Black Soy Sauce	1363	18	13.3	3.5	
LACHOY					
Lite Soy Sauce	612	21	13.5	2.2	47% less sodium
Lite Teriyaki Marinade & Sauce	463	23	22.1	1.6	47% less sodium
Soy Sauce All Purpose Seasoning	1323	23	11.3	3.2	
Soy Sauce All Purpose Seasoning	1289	23	10.6	3.0	
LEE KUM KEE					
Premium Soy Sauce ⁵	1091	18	13.5	2.8	MSG
MEE TU					
Soy Sauce	819	12	15.7	2.0	
Soy Sauce	895	30	12.4	2.3	
Teri-Yaki Marinade Sauce	871	24	17.3	2.2	
MITSUKAN					
Ajipon Sauce ⁵	657	48	6.7	1.7	MSG
Gyoza (Meat Dumpling) Sauce ^{5,6}	461	33	9.5	1.0	MSG
Shabu Shabu Sauce	571	31	12.1	1.5	
PATHMARK					
Soy Sauce	1084	26	9.5	2.6	

Table 3. Sodium, salt, MSG (monosodium glutamate), and calories per tablespoon (18 grams) in soy type sauce (continued).

Brand/style	Sodium, mg	MSG, mg	Calories, number	Salt, gms	Label
SAN-J Tamari Lite Gourmet Soy Sauce ¹	720	16	18.7	1.8	25% less sodium
SHOP RITE Soy Sauce	1283	21	9.7	3.2	
SUPERIOR Pearl River Bridge Soy Sauce	1195	13	8.8	3.2	
YAMASA Low Sodium Soy Sauce	958	19	14.0	2.2	
Soy Sauce ^{4,5}	992	19	11.5	2.5	MSG
Teriyaki Sauce ⁵	538	50	13.5	1.4	MSG
AVERAGE FOR ALL SAMPLES	856	26	12.0	2.2	

1 = labeled as containing alcohol

2 = labeled as containing sherry

3 = labeled as containing wine

4 = labeled as containing sake

5 = labeled as containing MSG (monosodium glutamate)

6 = only sample labeled as containing oil (sesame oil)



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